

Assessment of the sensitivity of radar backscatter to seasonal snow and vegetation thaw dynamics in a boreal ecosystem

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We examine the sensitivity of ERS-1 C-band synthetic aperture radar (SAR) backscatter to springtime snow and vegetation thaw dynamics for boreal forest stands within the BOREAS Southern Study Area (SSA) in Canada during the 1994 winter-spring thaw transition. A one-dimensional mass and energy balance model, SNTHERM, is applied to calculate surface energy exchange and associated snow cover dynamics at selected sites within the a 3500 km² portion of the SSA. SNTHERM calculates, at a stand scale, such snow properties as depth, density, grain size, and temperature for discrete layers within the snowpack. Previous work has integrated SNTHERM with a forest canopy model to account for effects of the vegetation on the snow cover at a stand scale. Spatially distributed SNTHERM results were then developed across the BOREAS SSA region. Multi-temporal backscatter imagery from the ERS-1 SAR is compared with spatially distributed snow property maps to assess the sensitivity of ERS-1 SAR backscatter to various modeled snow properties. We perform multiple regression analyses to assess the effects of the changing snowpack and vegetation state on the time series radar backscatter. Using point scale in situ biophysical and meteorological data for validation, this study elucidates the effects of the snowpack and vegetation condition on the radar signature during snowmelt. Results of this analysis lead to improved interpretation of radar-based monitoring of seasonal thaw dynamics in boreal landscapes.

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